

Introduction

The United States attempts to reduce the rate of extinction within its diverse and valuable biota primarily through the Endangered Species Act (ESA) of 1973. The ESA prohibits or severely limits the intentional or incidental taking of species that are listed as endangered or threatened. The ESA is ecologically practical in requiring that habitat necessary for each life-history stage (critical habitat) of a species be preserved and, if possible, expanded or enhanced. Among the requirements of the ESA, the prohibition of intentional taking is relatively easy to implement, the prohibition of incidental taking raises many practical difficulties because of its conflict with ordinary human activities, and the requirement for protection of critical habitat can be troublesome in the extreme because it often is in direct conflict with customary and valued uses of natural resources.

The ESA has been applied to the upper Klamath River basin of Oregon and California (Figure 1-1) for protection of the Lost River sucker (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*) and for the Klamath basin component of a genetically distinct population of coho salmon (*Oncorhynchus kisutch*) that is designated the southern Oregon/northern California coasts (SONCC) "evolutionarily significant unit" (ESU). The listing of these three fish species has, as required by the ESA, led to an intensive effort on the part of federal agencies and others to identify critical habitat and to propose federal actions that would promote recovery of the species. Analysis of the needs of the species has extended necessarily to private lands and to privately held water rights, given that the fishes range well beyond the boundaries of federal land and water management.

Requirements of the endangered and threatened fishes (see Chapter 9 for the difference between these two designations) came into especially sharp focus during 2001, a year of drought, when federal agencies, in an effort to protect these fishes, all but eliminated the distribution of water from Upper Klamath Lake for irrigation. The severe economic consequences of that decision for some segments of the Klamath basin community brought a sense of crisis to a controversy that had already developed around environmental, cultural, and commercial interests in fish as opposed to agricultural and economic interests in the uses of land and water.

This report presents the results of a study conducted by the National Research Council's (NRC) Committee on Endangered and Threatened Fishes in the Klamath River Basin. The



Figure 1-1. Map of the upper Klamath River basin showing surface waters and landmarks mentioned in this report. Source: modified from USFWS.

committee was formed at the request of the Department of Interior and the Department of Commerce, whose agencies are responsible for implementing requirements of the ESA in the

Klamath River basin. The committee's tasks were to evaluate the scientific merit of federal agencies' proposals or requirements for protection of the endangered and threatened fishes and to analyze the long-term requirements for recovery of these fishes. The committee's final report, which is given here, presents conclusions and recommendations that bear on the requirements of the endangered and threatened fishes. The committee hopes that its report will assist the federal government both in implementing the requirements of the ESA and in minimizing adverse effects of ESA actions on residents of the Klamath River basin.

OVERVIEW OF THE ENVIRONMENT

For purposes of environmental analysis, it is convenient to divide the Klamath River basin into an upper basin, which extends north and east from the Iron Gate Dam on the main stem of the Klamath River, and a lower basin, which extends south and west to the Pacific Ocean (Figure 1-1). The upper basin is dominated by the activity of large volcanoes and active faulting, which controls the location and shape of broad valleys. These fault-bounded valleys contain all of the large natural lakes and large wetlands of the Klamath basin. Crater Lake, the second deepest lake in North America and one of the most transparent of all lakes, is a notable geographic feature of the upper basin, but is irrelevant to the welfare of the endangered and threatened fishes because of its hydrologic isolation. The upper basin has a relatively dry, high desert climate typical of areas that lie east of the Cascade Range. The widespread volcanic rocks of the upper basin produce numerous springs that are important local sources of water.

Within the lower basin, below Iron Gate Dam, the Klamath River is incised deeply into bedrock, forming a narrow canyon. The mountains that surround the lower Klamath, including the Trinity Alps and Coast Ranges, are rugged, with dense conifer and fir forests and steep tributary streams. The climate is quite variable in the lower basin, but is distinguished by its very high annual rainfall and relatively mild temperatures. Some fertile valleys, including those of the Shasta and Scott rivers, are found in the lower basin.

Because the Klamath River flows directly to the Pacific, it is isolated from other inland waters. This isolation, which was compounded in the past by separation of the upper and lower parts of the Klamath basin, explains the high degree of endemism in the fish fauna of the basin (Chapter 5). Isolation also accounts for the spectacular ecological success, before human intervention, of the endemic fishes of the upper basin, as shown by formerly great abundances of the shortnose and Lost River suckers, which are adapted for living in a naturally variable high desert environment (Chapter 5). Although isolation has been less absolute for anadromous fishes, which occupy the lower basin and mix with other populations in the Pacific Ocean, the homing characteristics of salmonids in combination with regional selective forces have led to the presence of genetically distinct populations of anadromous fishes, including the SONCC population of coho salmon, in the lower Klamath basin and several adjacent drainages (Chapter 7).

With respect to water management, the upper basin has two parts: (1) waters draining to Upper Klamath Lake and (2) Klamath Lake plus all lands lying between it and Iron Gate Dam, including the Lost River basin. There are no lakes of significance to the endangered suckers above Upper Klamath Lake, but the streams and rivers above Upper Klamath Lake, especially

the Williamson and Wood rivers and their tributaries, historically were and still are important for spawning of the endangered suckers (Chapter 6). The Lost River historically was isolated from the rest of the upper basin in all but wet years and has a number of lakes that are or were important to endemic fishes. It is now hydrologically connected to the Klamath River through water management.

The issues of importance above Upper Klamath Lake include physical degradation and blockage of tributaries by dams or water-management structures and misdirection of fish through entrainment. Correction of these problems will involve private parties because most water management in this portion of the basin is not under federal control. As explained more fully in Chapter 2, cattle and irrigated crops are important.

Below the Upper Klamath Lake watershed, Upper Klamath Lake, Gerber Reservoir, Clear Lake, and the now small remnants of Lower Klamath Lake and Tule Lake all are affected by water management through the U.S. Bureau of Reclamation's (USBR) Klamath Project, as are the flows of all tributary waters (most notably the Lost River) that lie below all of these water bodies. Water management in this region is largely federal in that USBR delivers water from Upper Klamath Lake to the Klamath Project and also stores and routes water by using the other lakes and waterways. Thus, any loss of fish caused by hydraulic manipulation or water-management structures of the Klamath Project is the responsibility of USBR as it fulfills its contracts for delivery of water. Private water users, however, determine land use and application methods for water delivered by USBR and use privately-managed diversion structures and small dams to regulate the routing of water. Thus, both USBR and private water users may affect the suitability of environmental conditions for endangered suckers. Although the details are complex, the general pattern is that water stored in Upper Klamath Lake, Clear Lake, and Gerber Reservoir is diverted for agricultural use, and the unused portion of this diverted water is returned via Tule Lake, Lower Klamath Lake, or the Lost River to the main stem of the Klamath River (Figure 1-2). Approximate quantities of water flow are as shown in Table 1-1.

The upper basin contains seven national wildlife refuges and several other public and private preserves, as shown in Figure 1-3. The abundance of refuges and preserves in the upper basin is an indication of its exceptional value for waterfowl and other forms of life that depend on great expanses of shallow water and wetlands. Refuges and preserves around the lakes can be considered a means of conserving or enhancing wetlands that may be relevant to the welfare of endangered suckers.

Near Lower Klamath Lake and Tule Lake, water management is especially complicated in that the refuge lands within the original inundation zones of these two lakes now are used extensively for agricultural purposes according to agreements that were reached during the early history of the refuges (Chapter 2). The two lakes function hydrologically primarily as drainage conduits; they are not allowed to accumulate water because of governmental commitments to continuing agricultural use of the former lake beds. Thus, both lakes now lack the large populations of shortnose and Lost River suckers that once occupied them, although Tule Lake does still support a small population of endangered suckers (Chapter 6).

Also in the upper basin are six mainstem dams (Figure 1-4). The Link River Dam (completed in 1921), which is near the outlet of Upper Klamath Lake, is used in regulating the level of Upper Klamath Lake for water-management purposes and also produces hydropower. Irrigation water is withdrawn seasonally in large quantities through the A Canal, which is just

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Table 1-1. Flows Under Conditions of Average Water Availability in the Upper Klamath Basin (Approximate Only: Actual Values Differ from Year to Year)

Location	Amount (acre-ft per yr)
Upper Klamath Lake outflow ^a	1,300,000
Outflow April-September	500,000
Directed to Klamath Project	400,000
Directed downstream	900,000
Clear Lake inflow ^a	117,000
Directed to Klamath Project ^b	36,000
Gerber Reservoir inflow ^a	55,000
Directed to Klamath Project	40,000
Total Klamath Project consumptive use, including refuges ^a	350,000
Total Klamath Project returns to Klamath River ^a	100,000
Nonproject irrigation diversions, upper basin ^c	420,000
Total flow at Orleans ^d	6,000,000
Trinity River flow	3,800,000
Total flow at mouth	13,400,000

^aUSBR 2000a.

^bEvaporative losses are especially high in Clear Lake (long retention time and evaporation at about 3.8 ft/yr).

^cNMFS 2001 (estimated from percentages).

^dNear the mouth of the Klamath River, but above the Trinity River.

above the Link River Dam. Principles of operation of the dam are a major point of controversy related to the welfare of the endangered suckers (Chapter 6).

Below the Link River Dam are five additional dams; all the dams except the Keno Dam produce hydropower. All six dams are operated by PacifiCorp, a utility company, through agreements with USBR. Iron Gate Dam, the terminal dam, is used for reregulation of flow to the Klamath River mainstem. The six dams block access of both endangered suckers and coho salmon to large portions of their historical ranges and can be direct or indirect agents of fish mortality. Through the operation of Link River Dam, endangered suckers have been historically entrained into the A Canal and thus killed (Chapter 6). In addition, the suckers enter the unscreened intakes of the power-production facilities and thus may pass through turbines. Dams also are the means by which ramping of flow (change in discharge over short periods), which is consistent with optimal operation of hydropower production facilities, is achieved; ramping of flow can be detrimental to coho fry, which can become stranded at the river margin when flow decreases rapidly.

In the lower part of the basin (below Iron Gate Dam), the main stem of the Klamath River is the pathway of migration for numerous anadromous fishes and is important for spawning and rearing of some of them (Chapter 7). Flow to the main stem at Iron Gate Dam is reduced and altered seasonally through the operation of the Klamath Project and private water management above Iron Gate Dam and is regulated hourly by PacifiCorp (Chapter 4). Releases can be regulated to some degree by control of storage in Upper Klamath Lake, but irrigation

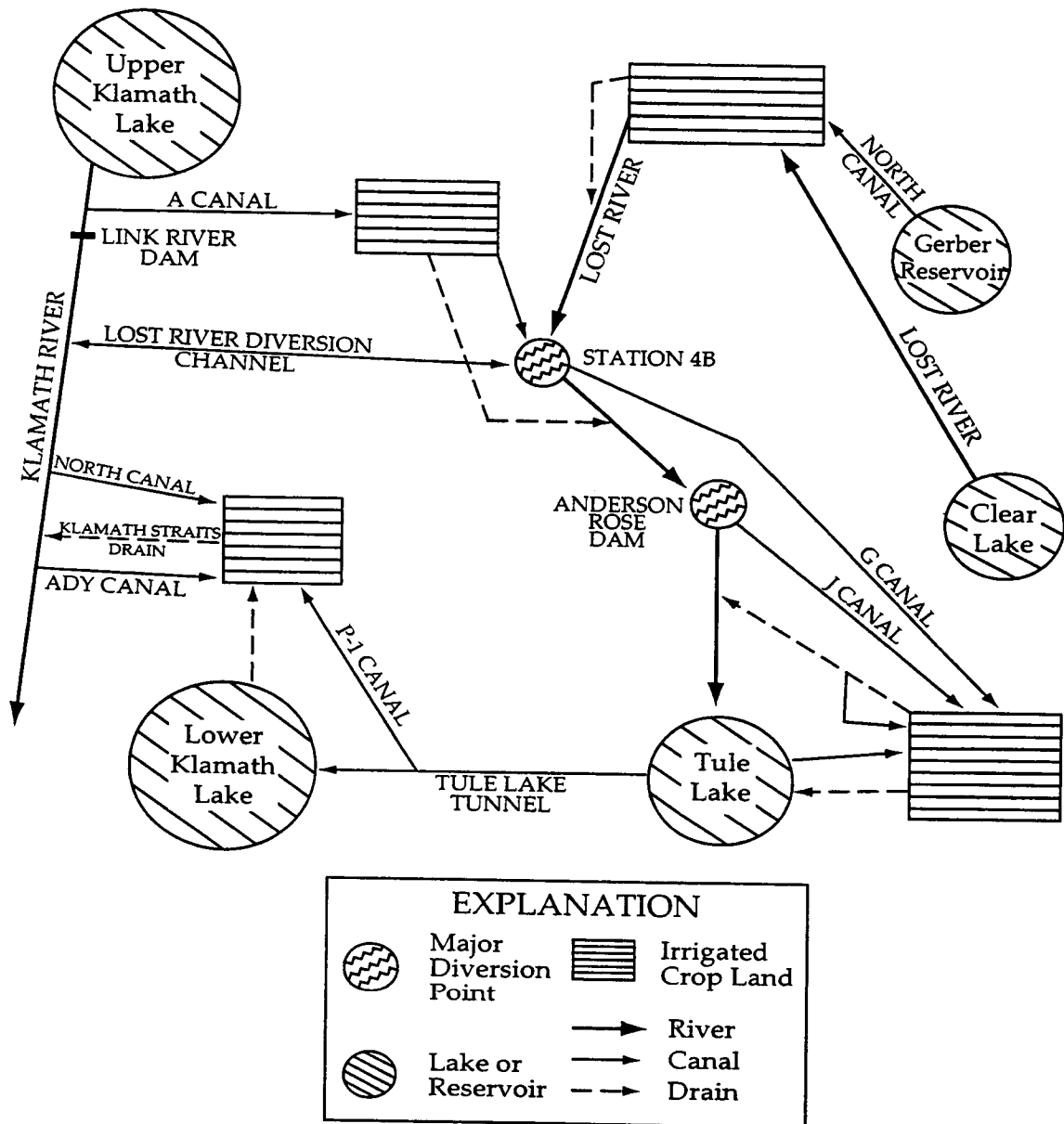


Figure 1-2. Water routing diagram for the Klamath Project. Source: modified from USFWS 2002.

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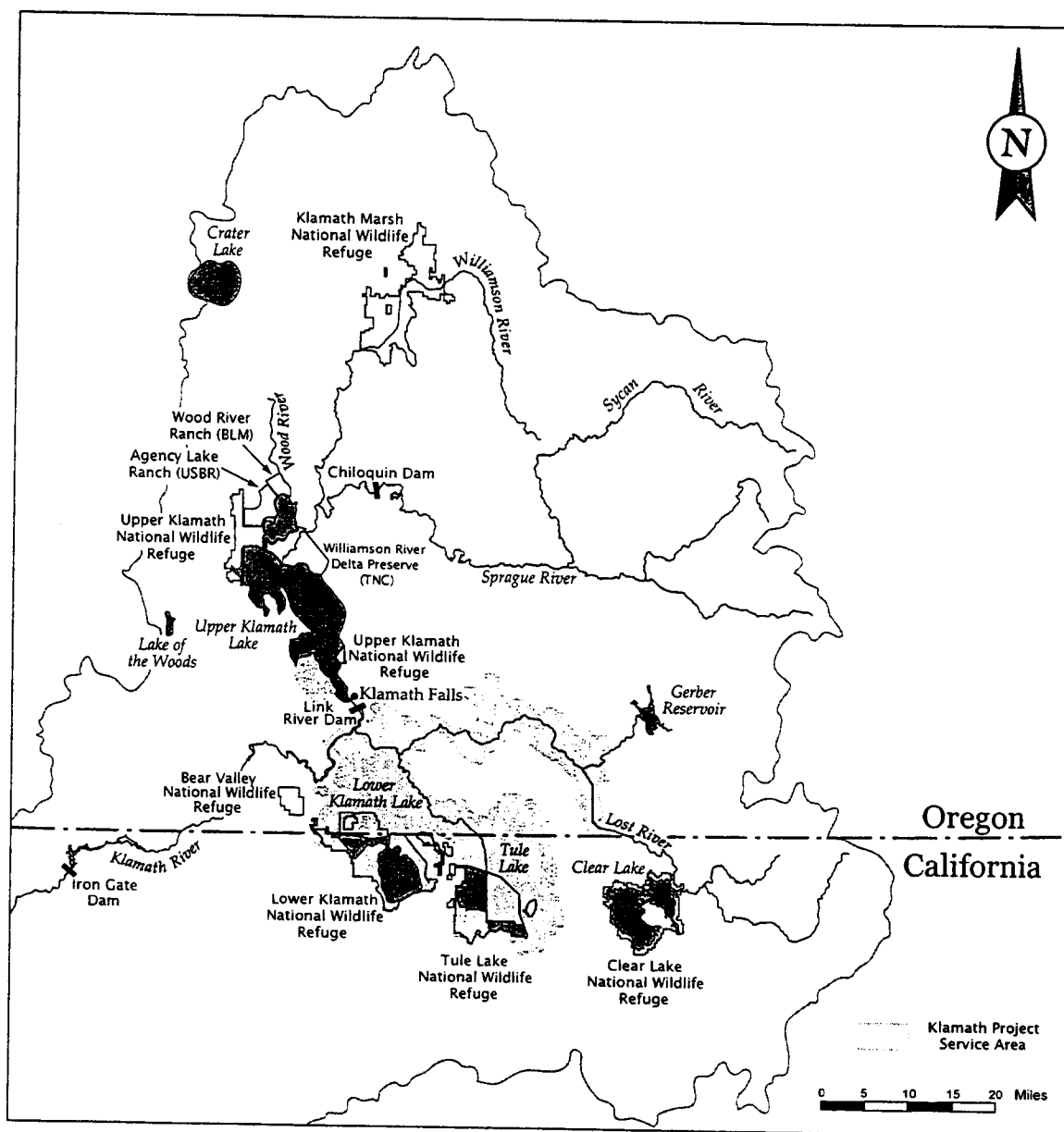


Figure 1-3. Map of the upper Klamath basin. Abbreviations: BLM, Bureau of Land Management; TNC, The Nature Conservancy; USBR, U.S. Bureau of Reclamation.

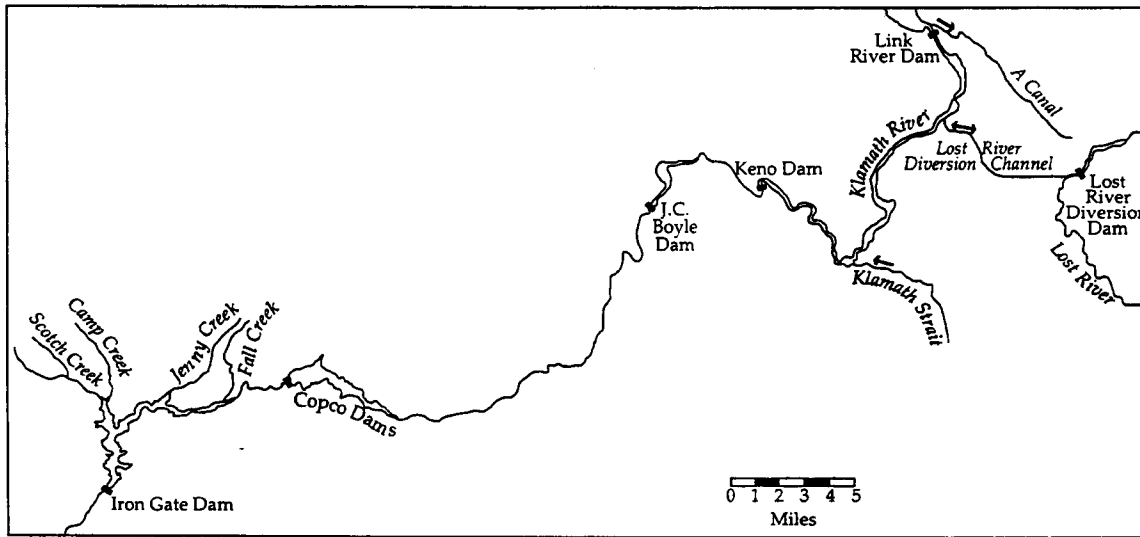


Figure 1-4. Mainstem dams on the Klamath River.

commitments constrain this management flexibility, especially in dry years. Although groundwater flow is substantial in some parts of the Klamath River basin, there appears to be little accrual of groundwater to the Klamath main stem below Iron Gate Dam. Increase in discharge downstream occurs through four large tributaries—the Shasta, Scott, Salmon, and Trinity rivers (Figure 1-1)—and through numerous small tributaries. The large tributaries all are physically altered, and some show severe depletion of flow and are excessively warm because of loss of riparian vegetation and high relative contribution of irrigation return flows to total stream discharge (Chapter 4). As explained in Chapters 7 and 8, the small tributaries now provide some of the best habitat for coho salmon. Land and water relevant to the welfare of the coho and other fishes in the lower basin are primarily under private control. Water-management structures interfere with the movement of fish in this part of the watershed, as they do elsewhere.

The Trinity River, which is the largest tributary of the Klamath River, reaches the Klamath about 43 mi from the estuary. In 1964, the Trinity River Diversion began delivering up to 90% of the upper Trinity's flow out of the basin to the Central Valley Project. This diversion and other changes in the watershed were followed by a severe decline in the anadromous fish populations of the Trinity River. Studies of coho salmon and other fishes of the Trinity River have been conducted separately from those of the Klamath River basin through processes prescribed by the National Environmental Policy Act, which involves an environmental impact statement (EIS) rather than ESA procedures. In December 2000, the EIS resulted in a record of decision (ROD) for the Trinity River (USFWS 2000). The ROD called for increased minimum flows, habitat restoration for the benefit of anadromous salmonid populations, and use of an adaptive management approach involving further study and evaluation of the outcomes of flow and habitat manipulations. As a result of judicial decisions, however, a supplementary EIS is still in progress. Recovery of the Trinity River coho populations is important for recovery of the

coho in the Klamath basin as a whole; hydrologic linkages between the two rivers are especially important for the migration of coho (Chapters 4, 7, and 8).

The hydrologic characteristics of the Klamath River main stem and its major tributaries are dominated by seasonal melt of snowpack. Summer storms and release of groundwater from springs also make contributions, but they are smaller in aggregate than the snowmelt effect. The schedule of melting differs from year to year, reflecting climatic variability, but a universal feature of hydrographs is a spring pulse in flow followed by recession to a baseflow condition by late summer. These main features of the hydrograph undoubtedly have influenced the adaptations of native organisms, as reflected in the timing of their key life-history features (see Chapters 5 and 7).

Even though water is now managed (Table 1-1), hydrographs of the Klamath River basin still show the dominant influence of snowmelt and spring precipitation on water flow. For example, Figure 1-5 compares the flow near the mouth of the Williamson River, above which there are no major impoundments, with the flow at Iron Gate Dam, above which a great deal of water management occurs. Flows at the mouth of the Williamson River are affected by privately managed irrigation diversions but, given the large total flow in the Williamson, the hydrograph has predominantly natural features. At Iron Gate Dam, the retention of water in reservoirs of the Lost River and in Upper Klamath Lake has the potential to alter the hydrograph more extensively. Alteration is, as expected, more severe during years of drought than years of average flow.

The management of hydrographs, in combination with natural climatic variation, now is a major focus of attention in the analyses of environmental factors that may affect the welfare of the two endangered sucker species and the coho salmon (Chapter 4). Hydrology has environmental effects not only through its direct control of physical attributes of standing and flowing water (mean depth, water velocity), but also because of its indirect control of other aspects of the physical, chemical, and biological environment such as temperature of flowing water, nutrient concentrations in lakes, and extent and type of aquatic vegetation. Even so, numerous influences on the endangered fishes, such as the introduction of nonnative fishes, loss of riparian vegetation, and anthropogenic mobilization of nutrients, involve factors other than hydrology.

THE FISHES

The shortnose and Lost River suckers are large, long-lived fishes of high fecundity. Although they spend most of their lives in lakes, flowing waters are important to them for spawning. Some subpopulations spawn around the perimeter of Upper Klamath Lake, particularly near springs, but fish of both species migrate or attempt to migrate into tributaries for spawning. Shortly after hatching, fry return to the lake, where they occupy very shallow water at first and move to progressively greater depths as they mature. The endangered suckers do not spawn until they are several years old (Chapter 5).

The two endangered sucker species were so abundant before colonization that they served as a major food source for Indian tribes (Chapter 2). After the Klamath basin was colonized, the fish were harvested in large numbers commercially. Because they are large and tend to migrate

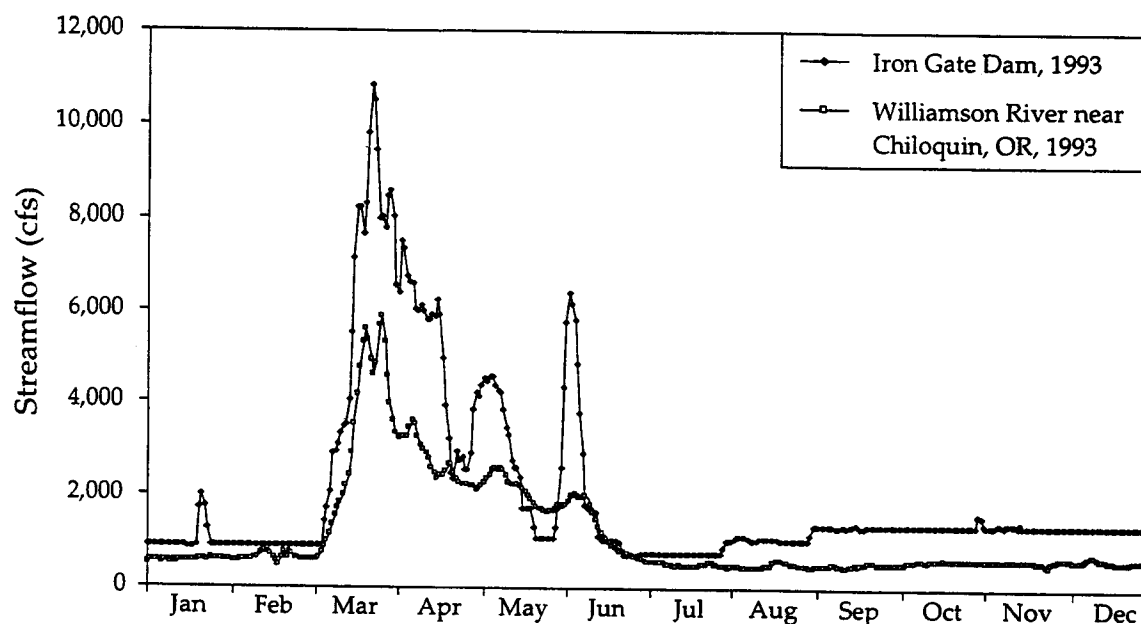


Figure 1-5. Flow of the Williamson River, the largest water source for Upper Klamath Lake, and of the Klamath River main stem (at Iron Gate Dam) in a year of near-average water availability. Source: USGS gage records.

during spawning, they were highly vulnerable, and their numbers were drastically reduced through harvest. Records of the size of spawning runs and sport fishing indicated during the 1980s that both species had declined to such a point that without special protection they might be extirpated. Fishing for the species was eliminated except for very small numbers of fish allocated for ceremonial purposes to Indian tribes. In 1988, both species were listed as endangered under the ESA (53 Fed. Reg. 27130, 18 July 1988).

It was clear in the 1980s and even earlier that prohibition of fishing, although essential, might not be sufficient to produce recovery of the endangered suckers. Factors that probably have contributed to the suppressed abundances of these species include blockage of migration pathways to spawning areas; entrainment of large numbers of fish by water-management structures; poor water quality, especially in Upper Klamath Lake; physical degradation of habitat; and adverse genetic consequences of scarcity and fragmentation (Chapter 6). Mass mortality of large fish in Upper Klamath Lake, although recorded for over 100 yr, caused particular alarm during the 1990s because of its sequential occurrence in 3 yr (1995-1997). The abundance of large adults appears to have been strongly suppressed by fishing, which was banned after 1987, and by mass mortality caused by poor water quality. Although recruitment of young fish has been documented since the listing of the suckers in 1988, there is no indication of recovery in overall abundances (Chapter 6).

Populations of coho salmon in the Klamath River were substantial when commercial salmon fisheries first developed (Chapter 7). Abundances of most anadromous fishes in the Klamath River basin and other Pacific coast basins have declined drastically since then. Decline

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of the coho salmon in the Klamath River basin led to federal listing of the SONCC ESU as threatened in 1997 (62 Fed. Reg. 24588, 6 May 1997); California listed the ESU as endangered in 2003.

The coho salmon, except in the case of some early-spawning males, has a 3-yr life history that is divided almost equally between marine and freshwater environments. A fall-winter migration brings the fish up the main stem of the Klamath River. Although some spawning may occur in the main stem, the primary spawning occurs in tributaries (Chapter 7). Young fish remain primarily in the tributaries or tributary mouths during development, after which they move downstream as smolts undergoing physiological transformation that is essential for life in marine waters. The many factors that are known or suspected to have contributed to the decline of the coho salmon include harvest (which is now prohibited), depletion of flows, anthropogenic warming of water, loss of cover, blockage of migration routes, and adverse water quality. In addition, the release of large numbers of hatchery-reared salmonids (coho and other taxa) introduces increased predation and competition.

Physical and chemical conditions in the tributaries are undeniably bad and can be remedied only through extensive remediation on private lands, either with or without facilitation by federal or state agencies. Examples of private efforts to promote recovery of salmon are already available for some parts of the Klamath basin (Chapter 8). USBR has considerable control over flows in the main stem, however, and the degree to which coho can benefit from changes in water management by USBR has been the subject of much controversy. The coho is strongly oriented toward tributaries for most of its life cycle, but the upstream migration of adults and the downstream migration of smolts involve the main stem. Thus, it is reasonable to ask whether regulation of flow in the main stem is important in holding back the recovery of the coho salmon; the evidence is reviewed in Chapter 8.

REQUIREMENTS OF THE ENDANGERED SPECIES ACT

With the listing of the coho and the two endangered suckers, the ESA introduced a new legal framework that has become the dominant factor in resolving water issues in the Klamath River basin, except for the Trinity River, where EIS procedures predominate. The listing of the two sucker species and the coho salmon triggered a suite of ESA regulatory requirements, as follows:

- Section 4 of the ESA requires the listing agency—the U.S. Fish and Wildlife Service (USFWS) for the endangered suckers and the National Marine Fisheries Service (NMFS) for the coho salmon—to designate “critical habitat” for endangered and threatened species unless exceptions, which are narrow, apply.
- Section 4(f) of the ESA requires the listing agency to develop and implement a “recovery plan” for endangered and threatened species.
- Section 7(a)(1) of the ESA requires all federal agencies, through consultation with the listing agency, to use their authority to carry out programs for the “conservation” of endangered and threatened species.

- Section 7(a)(2) of the ESA requires all federal agencies, through consultation with the listing agency, to ensure that actions carried out, funded, or authorized by them do not “jeopardize” the continued existence of endangered and threatened species and do not result in “adverse modification” of their critical habitat.
- Section 9(a)(1) of the ESA prohibits all persons subject to U.S. jurisdiction (including federal, state, tribal, and local governments) from “taking” endangered species unless authorized by the listing agency pursuant to appropriate provisions of the ESA; and section 4(d) allows the listing agency to extend the same level of protection to threatened species.

As explained in Chapter 9, some of these requirements have not been fully implemented for the endangered suckers and threatened coho salmon of the Klamath River basin. Nevertheless, primarily through the prohibition in Section 7(a)(2) against federal agencies causing “jeopardy” to listed species, the ESA, after the listings, has affected USBR’s operation of the Klamath Project. Primarily through the jeopardy-consultation procedure of Section 7(a)(2), USFWS has influenced USBR’s maintenance of water levels in Upper Klamath Lake for the protection of the endangered suckers and NMFS has influenced USBR’s releases from Upper Klamath Lake to the Klamath River main stem for protection of the coho salmon.

The full force of the jeopardy opinion manifested itself in the Klamath River basin on April 6, 2001, when, because USFWS and NMFS had concluded in their consultations with USBR that the proposed operation of the Klamath Project for delivery of irrigation water to USBR’s water-contract parties would jeopardize the endangered and threatened species, USBR determined that it could not deliver water through the Klamath Project. The social and economic consequences of that decision focused the attention of many observers on two of numerous conclusions given in the USFWS and NMFS biological opinions: that the continued existence of the species would be jeopardized unless USBR maintained the water levels in lakes that USFWS specified and the mainstem flows that NMFS specified. The ESA required USFWS and NMFS to base the jeopardy findings on the “best scientific and commercial data available” (16 U.S.C. 1536(a)(2)). Some observers questioned whether the two agencies had met that standard; others contended that the decision was fully justified.

Application of the ESA to fishes of the Klamath River basin puts into focus one of the central dilemmas of the ESA: the need to reconcile the ESA’s legal framework with its scientific foundations. For example, the ESA demands that USFWS and NMFS make clear distinctions as to whether an action will cause jeopardy, but the scientific process is not fully compatible with such sharp distinctions. Biologists studying the status of a species are likely to speak in conditional terms and only rarely to express the definitive conclusions that would be most useful for application of the ESA. Moreover, the listing and jeopardy-consultation procedures require that USFWS and NMFS use “best available” data, but such data often do not resemble the products of scientific review processes used by leading scientific journals. It may be possible, therefore, for USFWS or NMFS to satisfy the demands of the ESA with an analysis that would not satisfy the demands of scientific review for publication or other peer-review processes common in modern science. This issue is dealt with further in Chapter 9.

INTERESTED PARTIES

The work of NRC Committee does not involve conclusions or recommendations on economic or social issues, but the various interested parties that are present in the basin provide some context for evaluation of the controversies that have developed around the endangered and threatened fishes and thus the focus of scientific research on specific topics. Ultimately, the interested parties must work together on a sustained basis in order to achieve and maintain recovery of the listed species (Poff et al. 2003).

Indians were the first occupants of the basin; they now operate institutionally as the Klamath tribes (a group of related but formerly separate tribes, including the Klamath, Modoc, and Yahooskin Band of the Snakehead Indians) and the Yurok, Karuk, Shasta, and Hoopa Valley tribes. The tribes extensively used the fish of the Klamath River basin for food before the arrival of colonists, and they have cultural traditions involving the fish. The endangered and threatened fishes of the Klamath River basin, and numerous other fishes not now listed as threatened or endangered (see Chapters 5 and 7), are tribal trust species; the U.S. government has an acknowledged obligation to preserve these fishes for use by the tribes. Preservation of the fishes for use obviously implies water rights. The priority date for these water rights is "time immemorial." Thus, in the seniority system for water rights, tribal water rights related to the protection of fishes are senior to all others. Two practical issues, as yet unresolved, are how to translate the protection of fishes into specific amounts of water at specific points in the basin and the degree to which any such commitment would curtail other uses of water. These legal matters are directly relevant to research on the requirements of the endangered and threatened fishes.

The USBR, another interested party, has been working in the Klamath River basin for about a century. In 1905, Congress, Oregon, and California granted USBR authority to create the Klamath Project, which involved the acquisition of extensive water rights in the upper basin, the construction of storage and distribution systems, and extensive drainage of lakes and wetlands around Tule Lake and Lower Klamath Lake so that agriculture could displace the natural aquatic habitats there (USBR 2000b). The project matured over about a half-century and is considered to have taken its full modern operational characteristics in 1960. Thus, the interval between 1960 and today is often taken as the benchmark period for judging proposals for the future.

The USBR, as a federal agency, must follow all requirements of the federal government, even including those not associated with its mission, but it devotes its energy primarily to the orderly distribution of water in support of agricultural water use. The ESA requires, however, that USBR analyze and put into writing its assessments of the effect of Klamath Project operations on endangered and threatened species and that it enter into consultation about the assessments with USFWS (for suckers) and NMFS (for coho). In 2001, USBR issued two assessments (USBR 2001a, b) acknowledging that some aspects of project operations were harmful to the two endangered sucker species and to the threatened coho salmon. USBR proposed changes in operations that it believed would offset some of the adverse effects. The 2001 biological assessments were succeeded by revised assessments issued in 2002 (USBR 2002a), which proposed a plan of operations to extend over the next 10 yr. The revised assessments, which contain some additional proposals for amelioration of potential damage to the endangered and threatened species, are summarized at the end of this chapter.

The USFWS is charged with issuing biological opinions related to the endangered suckers of the Klamath River basin. It has been in consultation with USBR over the two endangered sucker species since the species were listed, and it has reviewed USBR's biological assessment of 2001 and USBR's 10-yr biological assessment of 2002. The role of USFWS is to analyze environmental information and set requirements for protection of the fishes, to issue the analyses as biological opinions, and through the creation of "reasonable and prudent alternatives" (RPAs), to call for changes in Klamath Project operations as it believes necessary to reduce risk to the endangered suckers.

The USFWS endorsed a number of proposals contained in USBR's assessment of 2001, but it judged the USBR proposals for control of water level to be inadequate overall for protection of the endangered suckers. The reasonable and prudent alternative proposed by USFWS in 2001 included prescriptions for higher water levels in lakes. Although USBR's assessment of 2002 (10-yr operating plan) was revised with respect to water levels, USFWS again found it to be inadequate overall and proposed its reasonable and prudent alternative, as described below.

The NMFS responded to USBR's biological assessment of 2001 on coho salmon and to USBR's 10-yr operating plan as given in its 2002 biological assessment. NMFS approved of a number of elements in the biological assessments of 2001 and 2002 but differed with USBR on the matter of minimum flows in the Klamath River main stem below Iron Gate Dam. As required by the ESA, NMFS issued a reasonable and prudent alternative prescribing higher flows in the main stem than had been proposed by USBR in 2001 and 2002.

The USFWS and NMFS ("the listing agencies") have the last word in judging the requirements of the endangered and threatened fishes. Thus, as of 2002, the USBR 10-yr proposal, as given in the 10-yr assessment, was in part rejected, and the listing agencies are requiring several new procedures and practices.

The USFWS also plays a second, very different role as manager of refuges in the Klamath basin. On the downstream end of the Klamath Project, the Lower Klamath Lake and Tule Lake refuges receive drainage water from the Klamath Project. The drainage water is used to manage the two refuges within constraints that are set by water availability and requirements for agricultural use of the land in or surrounding the refuges. In this role, USFWS is not able to demand specific amounts of water or specific timing for delivery of water to benefit the refuges. Instead, it negotiates with USBR and with agricultural interests for water to manage the refuges. Thus, although delivery of water to the refuges is required, it has a lower priority than the agricultural use of water or the agricultural use of land near the two lakes. The two uses of water are connected, however, in that some of the water delivered for agricultural use appears downstream for use by the refuges. Thus, curtailment of water for irrigation on the Klamath Project raises questions about the availability of water for the refuges.

Irrigators were present even before initiation of the Klamath Project and came in increasing numbers to use waters of the Klamath Project and waters in parts of the basin not affected by the Klamath Project. About 43% of consumptive use in the upper basin occurs outside the Klamath Project, and 57% occurs through the project, which irrigates about 220,000 acres. There is also a substantial amount of irrigation along tributaries in the lower basin beyond the boundaries of the Klamath Project. Agricultural uses of irrigation water are numerous

(Chapter 2), and include extensive production of alfalfa by use of sophisticated water-distribution systems and reuse of irrigation tail water.

Irrigators have consistently been skeptical of reasoning that suggests a need for changing water management for the benefit of endangered and threatened fishes; their consultants have entered the debate about the merits of various hypotheses underlying proposed changes in water use. The experiences of 2001, when the occurrence of a drought coincided with the USFWS and the NMFS biological opinions to make the delivery of irrigation water from the Klamath Project virtually impossible for the first time since the creation of the project, sharpened the objections but also have increased the interest of the agricultural community in restoration projects that may benefit endangered and threatened species without curtailing the availability of water (Chapters 2 and 4).

General environmental interests in the Klamath River basin are strong, in part because of the extraordinary value of environmental resources in the basin. Environmental interests have worked toward the moderation of consumptive use and the remediation of past damage to environmental resources. The Nature Conservancy, for example, has purchased a large tract of land on the northern shore of Upper Klamath Lake (Figure 1-3), where it is restoring wetlands (Chapter 2).

Oregon and California also are involved in assessing and forming opinions on endangered and threatened fishes in the upper Klamath basin. The states have placed the two endangered sucker species and the coho under special protection and have supported extensive studies, including those related to the Environmental Protection Agency's (EPA) total maximum daily load (TMDL) requirements, which are administered through the states (e.g., Boyd et al. 2001).

Logging, mining, and commercial fishing are important forces within the basin (Chapter 2). Logging and mining, although reduced from their past maximums, have been cited as sources of habitat degradation, but they operate outside the reach of the Klamath Project. Commercial and sport fishing for salmon and subsistence fishing by the tribes have been drastically curtailed in recent decades, first as a result of declining fish populations and then in a regulatory effort to protect the remaining stocks. The change has caused a loss of income and food for inhabitants of the lower basin.

The biological assessments and biological opinions on the endangered and threatened fishes have focused primarily on the operations of the Klamath Project because federal agencies must operate federal facilities in such a way as to avoid jeopardy to endangered or threatened species (Chapter 9). Other potential threats to the endangered and threatened fishes exist outside the range of the Klamath Project, however, and cannot be remedied solely through requirements related to USBR, which lacks direct control over use of land or water outside the area of the Klamath Project.

THE COMMITTEE

The cessation of water deliveries through the Klamath Project during 2001 as required by the jeopardy opinions on coho salmon and the two endangered sucker species of the Klamath River basin motivated the U.S. Department of the Interior and the U.S. Department of Commerce

to seek an outside evaluation of the scientific basis of the requirements set by USFWS and NMFS for higher water levels in Upper Klamath Lake and higher mainstem flows in the Klamath River. These federal agencies therefore asked the NRC to create a committee to be charged with external, independent review of the biological opinions and assessments and of the long-term needs of the endangered and threatened fishes in the Klamath River basin. As a result of the request, the NRC formed the Committee on Endangered and Threatened Fishes in the Klamath River Basin.

The committee was provided with a written statement of task, as given in Appendix A. The task has two components. First, the committee was asked to complete an interim report by early 2002. The interim report was to focus on the scientific strength of the biological assessments and opinions issued in 2001 on threatened coho salmon and endangered suckers in the Klamath River basin. The purpose of the interim report was to allow the federal agencies to consider a preliminary external review as they were writing their biological assessments and opinions for 2002, which they needed to do because the assessments and opinions of 2001 extended for only 1 yr.

Second, the committee was to prepare a final report to be issued in 2003. The scope of the final report includes the biological assessments and opinions of 2002 but also extends to all matters related to the long-term welfare of endangered suckers and threatened coho salmon in the Klamath River basin. Like the interim report, the final report focuses on the scientific basis of actions that are proposed or required by federal agencies for the benefit of the endangered and threatened fishes. Another important aspect of the final report is its analysis of the need for additional studies of specific issues about which there is too little knowledge to support confident proposals for remedial action.

The committee's interim report proved controversial. The committee found strong scientific support for all components of the reasonable and prudent alternatives given by USFWS in 2001 for the endangered suckers except for recommendations on maintenance of higher water levels in Upper Klamath Lake, for which the committee found no empirical support. At the same time, however, the committee found that USBR's recommendations, which could have caused mean water levels in Upper Klamath Lake to be lower than in the recent past, also were without scientific support. Thus, the committee's overall conclusion was that there was no substantial scientific evidence to support deviation from the water levels produced by operational principles that were in effect during the 1990s. Similarly, in reviewing the biological opinion of NMFS on the coho salmon, the committee concluded that all components of the reasonable and prudent alternative were supported scientifically except the one calling for higher flows in the Klamath River main stem. The committee found little scientific support for these recommendations in relation to coho salmon, nor did it find any scientific justification for the proposals of USBR, which would have allowed the river to be operated at lower mean flows than had been the case for specific categories of water availability applicable during the 1990s.

The committee, in drawing conclusions for its interim report, was bound by its charge to evaluate and comment on the scientific strength of evidence underlying various proposals. Its charge kept it from weighing economic concerns or weighing the advisability of minimizing risk by using professional judgment in place of scientific evidence to support particular recommendations. As explained more fully in Chapter 9, agencies charged with ESA responsibilities can be expected to use professional judgment when no scientifically supportable

basis is available for a decision, or where they judge the scientific support to be inadequate. Thus, the agencies may recommend practices for which the committee would find virtually no direct scientific support. The committee acknowledges the necessity of this practice in many situations where information is inadequate for development of scientifically rigorous decisions (Chapter 9).

For its final report, the committee adopted some specific conventions for judging the degree of scientific support for a specific proposal or hypothesis; Table 1-2 gives a summary. Any proposal for specific actions of a remedial or protective nature has an implicit or explicit underlying hypothesis that connects the proposed action with a beneficial effect on a threatened or endangered species. The scientific value of such a hypothesis ranges from negligible to very high, depending on the amount of testing to which it has been subjected. At the low end of the scale of scientific strength is an assertion or proposal that is entirely intuitive and thus without scientific support. For example, the catch phrase "fish need water" has been used as an assertion supporting increased water levels in Upper Klamath Lake and increased flows in the main stem of the upper Klamath River. The statement is true, but it does not constitute a scientifically valid argument for specific flows or specific water levels.

Professional judgment has more value than unsupported intuition. It typically is based on knowledge of the importance of various environmental factors or the requirements of various species in other locations or on general experience with or knowledge of the response of a particular category of organism to specific kinds of environmental challenges.

Professional judgment can be used in three ways, and the distinctions among them are quite important in the case of the Klamath River basin. First, for an issue about which there is no information whatsoever, an agency that is charged with protecting a threatened or endangered species can justify the use of professional judgment. Such agencies are charged with reduction of risk to the species; lacking site-specific information on a particular type of risk, they would logically draw analogies with the same or similar risks in other settings or for other species, or they would use general principles related to the known tolerance of particular species or groups of species. Although such an approach is weak in that the transferability of ecological knowledge from one set of circumstances to another is problematic, there is some scientific basis for it, and barring the feasibility of other approaches, it can be said to have weak but not negligible scientific strength.

Second, a resource agency might use professional judgment to endorse various proposals for action when valid scientific information contradicts it. This use of professional judgment is difficult to justify. The agency may hold to its desire to use professional judgment in preference to empirical information of direct significance to a particular issue on the grounds that something is wrong with the empirical information. Scientifically, however, sound and relevant empirical information always trumps speculation or generalization; an agency could argue the reverse only on the basis of a very conservative approach to risk.

Third, an agency might choose to use professional judgment that is consistent with a small amount of direct evidence. In this case, the use of professional judgment is reinforced rather than contradicted, and scientific support for it can be deemed moderate rather than negligible.

Table 1-2. Categories Used by the Committee for Judging the Degree of Scientific Support for Proposed Actions Pursuant to the Goals of the ESA

Basis of Proposed Action	Scientific Support	Possibly Correct?	Potential to be Incorrect
Intuition, unsupported assertion	None	Yes	High
Professional Judgment			
inconsistent with evidence	None	Unlikely	High
Professional judgment with evidence absent	Weak	Yes	Moderately high
Professional judgment with some supporting evidence	Moderate	Yes	Moderate
Hypothesis tested by one line of evidence	Moderately strong	Yes	Moderately low
Hypothesis tested by more than one line of evidence	Strong	Yes	Low

A step beyond professional judgment is the empirical testing of scientific hypotheses involving cause and effect. If a properly designed single line of evidence is developed as a means of testing such a hypothesis, and the hypothesis is not invalidated, scientific support for the hypothesis can be considered moderately strong. Ideally, this approach would be extended by the collection of additional, independent evidence through which the hypothesis could be tested in a different way; barring contradiction between the evidence and the hypothesis, the hypothesis could be considered a theory of considerable strength to be relied on in proposing and pursuing vigorously the action upon which the hypothesis is based.

The committee has used the six-tiered system summarized in Table 1-2 and described above in assessing the scientific basis of actions that have been recommended in the Klamath basin for protection of the endangered suckers and threatened coho salmon. It found its greatest differences with the resource agencies in the second category: instances in which the agencies have used professional judgment that is contradicted by scientifically valid, relevant evidence. In carrying out its task to categorize the scientific support for specific proposals, the committee would characterize any proposal justified by such means as having negligible scientific support. This does not preclude the resource agency from using such an approach, but the justification for it would involve extreme sensitivity to risk, and in this way might be judged not reasonable.

The committee's charge requires that it estimate the costs associated with its recommendations. For the recommendations involving additional research or monitoring, the committee was able to approximate costs based on the experience of the committee members with similar types of research. Even so, the mode of implementation of a particular research program could cause costs to deviate markedly from the committee's estimates. For example, implementation could involve a much broader or narrower geographic scope than suggested by the committee, or it could involve multiple organizations in a way that would increase costs. The committee also was able to estimate, on the basis of general experience, the costs of selected minor restoration activities. The committee did not attempt, however, to estimate costs for major restoration activities. In most instances these activities must be studied for feasibility prior to the

time any commitment is made to them, and their final approval and execution may be complicated to an extent that cannot be meaningfully judged by the committee in terms of cost.

SUMMARY OF THE BIOLOGICAL ASSESSMENTS AND BIOLOGICAL OPINIONS OF 2002

The biological assessments issued by USBR in 2001 and the biological opinions issued by USFWS and NMFS in 2001 all expired after 1 yr, so new assessments and opinions were issued in 2002. The assessments and opinions of 2002 differ from those of 2001 in several respects. First, they cover a 10-yr interval rather than a 1-yr interval. In working with 10 yr rather than 1 yr, the agencies are cooperatively attempting to stabilize and add flexibility to management in such a way as to benefit both water use and environmental remediation. At the same time, consultation between the agencies probably will continue, and requirements of USFWS and NMFS probably will be modified within the 10-yr interval as new information becomes available. Reinitiation of consultation is required by ESA Section 7 under some circumstances, and both USBR and NMFS must issue a new biological assessment and opinion in any case because of the ruling of a U.S. District Court (see below). The texts of assessments and opinions of 2002 show that they were influenced to some extent by the committee's interim report. The interim report was not binding on the agencies but provided a basis for additional consultation and appears to have stimulated some new kinds of discussions among the agencies.

Endangered Suckers

The USBR Biological Assessment

The USBR, which in 2001 had prepared two assessments (one for the threatened coho and one for the two endangered sucker species), dealt with all three species in a single document during 2002. This makes sense because water resources at times of scarcity must be shared not only among consumptive uses and listed species but also among the listed species themselves, given that the coho and the suckers occupy different parts of the basin. USBR proposed maintenance of specific water levels in lakes and some other actions previously suggested by USFWS or others, reflecting the consultation process through which gaps between the viewpoints of the agencies are intended to be minimized.

Table 1-3 lists in abbreviated form the commitments that USBR made in its 2002 assessment to accommodate the needs of the endangered suckers. It proposed to manage water levels in Upper Klamath Lake, Clear Lake, and Gerber Reservoir so as to stay within the operating ranges of the 1990s. Specifically, it proposed not to allow water levels to fall below the 1990-1999 minimums for specific water-year categories and not to allow the mean water level for any water-year category to decrease through increased average drawdown. Thus, the water-level proposals in the assessment were responsive to the criticism made by the committee in its interim report (2002) that the USBR proposal of 2001 would have allowed, without any

Table 1-3. Summary of Commitments of the USBR Biological Assessments of 2002 that are Relevant to the Two Endangered Sucker Species

Assessment Commitments
Water levels in Upper Klamath Lake, Clear Lake, and Gerber Reservoir:
Maintain water levels at or above 1990-1999 minimums for specific water-year types ^a
Maintain mean water levels at or above 1990-1999 means for specific water-year types
Establish water bank of about 100,000 acre-ft
Use specific procedure for determining annual operations, including 70% exceedance principle for water availability
Coordinate externally and produce annual report on operations
Reduce entrainment and enhance passage in Link River and at other locations
Enhance water supply
Cooperate with USFWS in operation of refuges

^aSpecial concerns and procedures are clarified by subsequent memoranda on Clear Lake and Gerber Reservoir (USBR, unpublished memo, February 21, 2003; USFWS, unpublished memo, March 4, 2003).

ecological rationale relevant to the suckers, greater mean drawdown within any given water-year category.

A second element of the assessment is a water bank, which USBR proposed to be as large as 100,000 acre-ft. The water bank would provide operational flexibility in meeting multiple needs for water during years of water scarcity and would help USBR to ensure that water-level targets in lakes (or flow requirements at Iron Gate Dam, for coho salmon) would be met.

USBR also proposed a procedure for developing project operations in a particular water year. The procedure would begin in April with classification of the year by water-year type—above average, below average, dry, or critical dry (see Chapter 3 for details)—through the use of forecasts from the National Resource Conservation Service (NRCS). A 70% exceedance factor would be used in applying the forecast; that is, forecasts of the availability of water for the Klamath Project would be conservative in that there would be a 70% chance that the forecast would be equaled or exceeded by actual water availability. Having thus classified a developing water year as belonging to one of the four categories, USBR would follow specifications on minimum water levels for the appropriate water-year category. A second, later calculation would facilitate maintenance of water levels in lakes no lower than the average (rather than the minimum) end-of-month elevations for specific water-year types over the interval 1990-1999.

Another component of the assessment was a commitment to an annual report on operations, which would be useful because of the general interest in operations and the difficulty of discovering the details of operations without an interpretive document. Coordination not only with USFWS, as required through ESA, but also with other groups is a component of this portion of the assessment proposal.

The USBR proposed to reduce entrainment of fish by diversions and to increase fish passage in the Link River. Specifically, entrainment of fish at the A Canal is known to be large. Entrainment of fish above a size of about 30 mm would be reduced by installation of a permanent fish screen by a specified date (April 1, 2004). Salvage operations are included, as are measures to promote fish passage at the Link River Dam to be completed in January 2006. Increase in water supply through increased storage capacity and leasing also is a component of

the proposals from USBR for 2002, but details are not yet available. Because these measures would require congressional approval and funding, they were not attached to a specific schedule in USBR's assessment.

The USFWS Biological Opinion

In responding to the portion of the USBR assessment dealing with endangered suckers, USFWS, through its biological opinion of 2002, reacted favorably to a number of the USBR proposals, including the water bank and specifically scheduled actions intended to reduce entrainment and improve fish passage. In the text of its opinion, however, USFWS expressed its position that water levels higher than those proposed by USBR would be favorable to the suckers through improvement in water quality and maintenance of habitat (see Chapters 3 and 6). Overall, USFWS found that the operations proposed by USBR would leave the two endangered sucker species in jeopardy and therefore formulated an RPA under which USBR must operate (Table 1-4).

The USFWS concluded that low water levels in the lakes are less favorable than high water levels to the welfare of the suckers. It required that water levels in the lakes not deviate from minimums (for single years) or averages (for groups of years) of the 1990s for specific categories of water years, as proposed by USBR. In addition, USFWS required through its RPA that USBR use a 50% exceedance probability rather than a 70% probability in forecasting water availability. As shown in the USFWS biological opinion, use of a 70% forecast, although favorably conservative for water-management purposes in tending to underestimate water availability, could be unfavorable from the environmental point of view if it were allowed to justify water-level drawdown in lakes more extreme than would be consistent with the actual availability of water. Thus, USFWS justified the 50% exceedance requirement for estimates as a means of ensuring that estimates of water availability would not be biased. Currently, it appears that USBR and USFWS are in agreement that April projections can be corrected as appropriate whenever they later appear to have been in error (USFWS 2002; p. 118).

A second element of the RPA was to reduce entrainment of fish at Link River Dam and hydropower intake facilities. USBR had committed to screening the A Canal, but it did not make the same commitment for the power-production facilities at Link River Dam. Thus, the USFWS RPA appears to extend USBR's commitment to screening. This requirement of the RPA raises questions about the feasibility of requiring USBR to manage entrainment for facilities that are operated by PacifiCorp, a power production company. The application of this feature of the RPA to the Link River Dam will depend on the nature of the federal action that USBR takes with respect to PacifiCorp's operation of the facilities. If USBR has sufficient discretionary authority over PacifiCorp's operation within the meaning of ESA Section 7 (carry out, fund, or authorize operations) for the facilities to be properly within the scope of the interagency consultation, the RPA would be an appropriate component of the USFWS biological opinion. If not, USFWS would need to explore application of ESA Section 9 to PacifiCorp and determine whether PacifiCorp would be in violation of the ESA in the absence of screening and other measures that may be developed between USFWS and PacifiCorp (see Chapter 9). Thus, USFWS and USBR still must clarify the status of the Link River Dam operations under Section 7 of the ESA.

Table 1-4. Summary of Components of USFWS Biological Opinions of 2002 that are Relevant to the Two Endangered Sucker Species of the Klamath River Basin

Component of Biological Opinion ^a
Use 50% rather than 70% exceedance probability for planning water levels in Upper Klamath Lake
Screen power-plant intakes at Link River Dam
Study cause of death and habitat needs of endangered suckers in Upper Klamath Lake
Take actions leading to more favorable water quality and expansion of habitat
Monitor populations of endangered suckers
Produce annual assessment report on suckers
Follow specific implementation schedule

^aComponents shown here are in addition to proposals of the USBR in its biological assessment.

Other requirements of the biological opinion are that USBR study the causes of mass mortality of fish and access of endangered suckers to habitat in Upper Klamath Lake, take actions designed to reduce unfavorable aspects of water quality or limitations in sucker habitat, monitor populations of endangered suckers, and produce an annual assessment report. A detailed implementation schedule and requirements for collaborative work of USBR with other parties accompany this element of the RPA.

Threatened Coho Salmon

The USBR Biological Assessment

In its biological assessment of 2002, the USBR made a number of proposals relevant to coho salmon, as shown in Table 1-5. First, USBR committed itself to maintain river discharges no lower than those observed during 1990-1999 for the categories of water years that it uses in water management. It also committed itself to maintain interannual averages no lower and sometimes higher than interannual averages of 1990-1999 for specific categories of years, thus answering the concern expressed in the committee's interim report that a commitment to maintain minimums without a commitment to maintain averages would in fact allow future operations to produce lower averages.

As was the case for water levels of Upper Klamath Lake, Clear Lake, and Gerber Reservoir, USBR proposed to use a 70th percentile exceedance factor applied to the April 1 forecast of NRCS for planning annual operations. For above-average and below-average years, USBR proposed to provide flows no lower than the minimums observed during the 1990s and also no lower than the Federal Energy Regulatory Commission (FERC) minimums if the FERC minimums happen to be higher. For the two drier categories of years (dry and critical dry), USBR proposed to provide flows no lower than the observed averages for the 1990s and also to provide 10,000 acre-ft of additional flow during April to facilitate smolt migration. The use of averages rather than minimums from the 10-yr observation period is a commitment of additional

Endangered and Threatened Fishes in the Klamath River Basin

Table 1-5. Summary of Components of USBR Biological Assessments of 2002 that are Relevant to Threatened Coho Salmon of the Klamath River Basin

Assessment Component
Discharge of water from Iron Gate Dam
Above-average and below-average years: monthly flow will be no lower than 1990-1999 year minimums or FERC minimums, whichever is greater
Dry and critical-dry years: monthly flow will be no lower than actual 10-yr averages plus pulse of 10,000 acre-ft in April
Establish water bank of about 100,000 acre-ft
Use specific procedure for determining annual operations, including 70% exceedance principle
Coordinate externally and produce annual report on operations
Enhance water supply

water above what had been committed by USBR in its 2001 assessment, as is the 10,000 additional acre-ft for April.

An additional component of the proposed operating plan for any given year is the establishment and operation of a water bank, which also serves the needs of endangered suckers, ultimately to be as large as 100,000 acre-ft. Mechanisms for water banking could involve offstream storage but also could include reduction in irrigation demand with compensation to irrigators and conjunctive use of groundwater and surface water to provide a buffer that would be especially useful in dry years (Chapter 10).

The USBR proposal also made a commitment to coordination extending beyond the ESA implementation agencies to include the tribes, PacifiCorp, and private water users. Coordination would be supplemented with an annual report documenting the preceding year's activities. Enhancement of water supply, not necessarily limited to the water-banking concept, was also an element of the USBR proposal.

The NMFS Biological Opinion

After consultation with USBR during 2002, NMFS concluded that proposed actions of USBR as presented in its 2002 biological assessment, although containing several constructive components, would leave the threatened coho in jeopardy. Thus, according to the requirements of the ESA, NMFS prepared a biological opinion containing an RPA summarized in Table 1-6. In revising its biological opinion of 2001, NMFS recognized that the Klamath Project accounts for about 57% of the total irrigation-related depletions of flow at Iron Gate Dam. Thus, according to the opinion of 2002, it would not be reasonable to require USBR to provide directly and immediately all increments of flow judged by NMFS to be necessary for improvement of habitat in the main stem of the Klamath River below Iron Gate Dam. Accordingly, NMFS assigned USBR a 57% share in the responsibility for providing flows in the main stem to meet the requirements of the threatened coho as judged by NMFS. In doing so, however, NMFS did not absolve USBR entirely of responsibility for making up the other 43% of flows. The

Table 1-6. Summary of Components of NMFS Biological Opinions of 2002 that are Relevant to Threatened Coho Salmon in the Klamath River Basin

Component of Biological Opinion ^a
Apply 57% rule for proportionate USBR direct responsibility for flow at Iron Gate Dam
Use task force to develop the 43% additional flow from nonproject sources
Use phased approach to raising flows and lowering temperatures
Develop water bank (100,000 acre feet) on specific schedule
Adopt water-year types as identified in draft phase II flow study report (Hardy and Addley 2001)
Limit ramping rates below Iron Gate Dam
Conduct designated scientific studies with advice from external experts

^aComponents shown here are in addition to proposals of the USBR in its biological assessment.

biological opinion requires USBR to facilitate and coordinate a phased effort to provide capacity for the additional flows.

NMFS, as part of the RPA, requires USBR to build a water bank, which USBR has agreed to be its preferred method for meeting its obligation to provide the 57% of flow shortfalls that NMFS will require it to provide for support of the threatened coho salmon (specific flows are shown in Table 9 of NMFS 2002 and in Chapter 4 of this report). USBR must create a water bank to 100,000 acre-ft capacity by 2006 according to the RPA. A U.S. District Court judge found during July 2003, however, that reliance on the water bank is unjustifiably speculative until more particulars are given. Thus, USBR soon must issue a new biological assessment in consultation with NMFS, which must issue a new biological opinion.

In its recommendation for flows, NMFS gave greatest emphasis to improvement of the conditions for smolt migration, probably because tributary conditions are most important for spawning and rearing, while the main stem performs a critical and irreplaceable function in smolt migration (Chapter 7).

In prescribing flows, NMFS did not follow the method of USBR in assigning specific water years to categories. NMFS used estimates of unimpaired flows from the Hardy Phase II draft report (Hardy and Addley 2001) and the idea that the shape of the natural hydrograph and a natural range of interannual variabilities should be represented as completely as possible in the flows of the main stem. The five categories and their percentiles used by NMFS in its flow prescriptions for the Klamath main stem are as follows: wet years, 10%; above-average years, 30%; average years, 50%; below-average years, 70%; and dry years, 90%. The percentile in each case indicates the proportion of years that would exceed the unimpaired monthly flows. The RPA provides specific dates by which USBR must meet the flow requirements.

NMFS specified upper limits on ramping rates below Iron Gate Dam. The specifications are more stringent and more detailed than those governing previous operations. As in the case of screening plant intakes, however, the direct responsibility for meeting this requirement may lie with PacifiCorp rather than USBR.

According to the RPA of 2002, USBR is required to convene a panel of experts capable of identifying studies that improve the current understanding of relationships between river discharge and welfare of coho salmon. One specific element of the studies is a test of the effect of various flows on thermal refugia in the main stem of the Klamath River.

Overview of the 2002 Biological Assessments and Opinions

The USBR assessment and the accompanying biological opinions of USFWS and NMFS for 2002 reflect considerable constructive interaction among the agencies between 2001 and 2002. There is still a gap between the assessments and the opinions, but the gap has narrowed from 2001 through some carefully considered movement toward consensus among the three agencies. USFWS and NMFS are requiring some substantial actions beyond those proposed by USBR. In general, however, the actions adhere more closely than those given by the listing agencies in 2001 to the relevant available scientific evidence or to professional judgment reinforced by at least some scientific evidence. As explained in this report, USFWS and NMFS in a few instances have made requirements based almost entirely on professional judgment, without direct scientific support, as is their prerogative. In doing so, however, they appear to have made a special effort to frame their requirements in such a way as to cause minimal impairment of Klamath Project operations and, in contrast with 2001, have recognized the inevitable need to include parties other than USBR in modification of environmental conditions for the benefit of the endangered and threatened fishes.

CONTEXT FOR THE COMMITTEE'S REPORT

The NRC Committee has evaluated a very extensive accumulation of data collected both in the field and laboratory, historical records of various kinds, opinions and interpretations by individuals intimately familiar with the environmental conditions in the Klamath, and numerical analyses of many kinds. Though the documentation for questions related to endangered and threatened fishes in the Klamath basin is impressive in scope and volume, it must be viewed as a preliminary step toward what eventually can and must be known about the Klamath River basin in support not only of the recovery of endangered fishes but also of the more general restoration of aquatic environments in the Klamath basin. As will be shown by this report, the number of firm conclusions that can be reached about cause-and-effect relationships still is modest, yet these types of conclusions are essential for planning, managing, and predicting the outcomes of actions in the Klamath River basin. The NRC Committee sees its own work only as a best effort given the information available; the committee fully expects to see new kinds of data and new tests of ideas yield insights that the committee could not have anticipated based on current information. Effective efforts to cause recovery of the endangered and threatened fishes rests on information, and the committee urges the creation of new information that will place management decisions on increasingly firm ground.